A COMPUTATIONAL TOOL TO ANALYZE THE EVOLUTION OF STUDENT LEARNING

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Abstract

Currently, information, technology, communication and interaction are important allies of the learning process. Teachers and students are increasingly closer to resources such as tablets, smartphones, virtual labs, virtual learning environments and other technologies that are strongly focused on improving the quality of education. The technologies are not intended to replace traditional methods of learning or teachers. The goal is to be a tool that supports the learning process enabling the student to create opportunities in an environment where they can develop their skills better. While students are awakened to a new form of learning, the teacher is able to watch the evolution or involution of the students. This is only possible if you have at their reach tool that monitors the learning process and generate data for the teacher to intervene on behalf of students. In this context, we propose a computational tool that aims to analyze the student's behaviour in inherent aspect of the learning process. Our tool gives conditions for the teacher to identify the student’s level of success in their subject in order to achieve a special work which the final goal is to identify flaws in the learning process.

Keywords: Learning Environment, Educational Technology, Learning Tool, Informatics in Education.

1 INTRODUCTION

Currently, resources of communication, collaboration and interaction between students and teachers are important allies for the qualification of teaching and learning. Collaborative learning environments, computational tools of interaction and visualization, as well as educational content available anytime, anywhere, are resources that can enhance the quality of education of students. Among these technologies, e-learning (Electronic Learning) and m-learning (mobile learning) are increasingly used in learning environments. They allow the teaching classroom without the presence being supported by information and communication technologies.

E-learning enables the acquisition of information anytime and anywhere [2]. It uses the potential of the internet for communication and content distribution, allowing interaction synchronously or asynchronously. Some advantages of e-learning can be highlighted, such as the rapid update of content, the ability to customize these contents, more affordable, flexible schedules, availability of content permanently, transposing the problem of geographical distance, among others.

In the same way that e-learning, a new technology has been gaining ground in recent times, the m-learning. The m-learning is intended to take education through distances via mobile devices such as smartphones, tablets, netbooks and notebooks. They have become products used by most of the world population, regardless of social class. These devices can be used for different purposes, among them education, since they are useful tools for developing skills related to learning. Some authors claim that the new technological resources leverage the traditional teaching strategies applied by most teachers, especially if these resources are available during basic training.
Research on systems of distance learning may involve diverse interests and efforts in several areas, such as intelligent tutoring systems, hypermedia systems, adaptability and customization of environments based on user interests [1]. Our proposal is supported by a learning environment based on the web that allows to evaluate student behavior when it answers questions provided by the teacher. The development of this proposal was motivated by the need to create opportunities for the teacher to assess the progress of students in a faster and more interactive way.

The paper is organized as follows. In Section 2 we discuss studies that are related to our proposal. Section 3 specifies the tool development. The application possibilities of our proposal are discussed in Section 4. Finally, Section 5 presents the concluding remarks and future work.

2 RELATED WORKS

Several papers address issues related to the use of computational tools in learning environments. Some have features such as sending educational materials, chats, forums, monitoring the progress of the discipline and various other mechanisms for interaction between teacher and student.


Various systems and tools have been proposed to support the learning of students. Moodle\(^1\) is a type of Course Management System (CMS) or Learning Management System (LMS) using the Web as a communication vehicle. It has many features, such as forums, wikis, chat, and availability of classes' materials. One of the possibilities in Moodle is that it allows collaborative work among its users, which stimulates and strengthens collaborative learning.

Another system that stands out is the AdaptWeb\(^2\) [4]. It is a tool that aims to nurture the adaptability of the environment on the profiles of students with different characteristics. This involves adapting the presentation, navigability and content according to the profile of the student who is interacting with the system. It allows the creation of profiles of students that can be configurable, since it stores the navigation information, and preferably history student behavior in the environment. Thus the system learns from the student’s behavior and adapts to your profile, making for more efficient interaction and increasing the ability to provide useful information to the student.


Our proposal differs from other studies by presenting a tool that allows the teacher to monitor student performance through analysis of evolution or involution of each student.

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\(^1\) https://moodle.org/

\(^2\) http://sourceforge.net/projects/adaptweb
3 THE TOOL TAES

This article presents the Taes - Tool to Analyze the Evolution of Students. The Taes is a tool that aims to improve the process of teaching and learning through a computing environment. It allows the teacher to monitor the evolution or involution of students in a planned, interactive and fast way. The Taes is grounded in an environment where the teacher can create and configure questions or group of questions to be applied to the students. When the student answers the questions, the teacher can assess their individual performance and suggest activities for student growth. Fig. 1 shows the architecture of Taes and, just below, its operation.

Taes consists basically in an environment where the teacher prepares questions that are presented to students. The questions can be multiple choice, true or false, relate columns or association. Students answer questions using laptops, tablets, smartphones, computers or any other device that is connected to the internet, since the Taes is a Web-based tool.

Student and teacher have an individualized and personalized environment, where each type of user can access proprietary modules that have unique features in each case. Internally, the Taes is divided into modules. Each module contains the features implemented for the execution of actions which together will enable analysis of the results promoted by the tool. Below, we present a modular structure and operation of each segment:

- Teacher Interface: The interface allows the teacher to create, edit and delete questions, evaluate responses, summarize the results and analyze the evolution.
• Student Interface: The interface enables the student to resolve issues, visualize results and analysis of personal evolution.

• Module Configuration Questions: The configuration module allows the teacher to set up and create questions and their answers in order to customize the question and answer according to the level of the class or the student. In this module the teacher can create tests from previous saved questions or tests, through a search, making it easier and faster to generate tests.

   The teacher can choose the style of question that will be applied - such as multiple choice questions, true or false, relate the columns. It is also where the teacher adds keywords to each question and each test, marking issues, topics and contents that are related so that the analysis results are more tactile, identifying which subject a class learnt really well, or which subject a student has more difficulty in learning, for example. One of the many possibilities in this module is to enable the union of keywords with the weights of the alternatives that the student will respond. The weights are 1, 2, 3, 4 and 5, where 5 is the correct alternative and 1 is the less accurate alternative. This is how the teacher can measure how wrong was the student. The more their response approaches to 5, more knowledge they acquired on that subject. The more their response approaches to 1, more learning difficulties the student presents.

• Module Applies Questions: This module aims to apply the questions to the student. The application is done by visualization of the questions in the Student Interface, where the student answers what was asked of him and sends responses, making them available to the teacher and for any type of analysis desired.

• Module Analyze Results: The teacher is provided with mechanisms to visualize the evolution or involution of student, generating statistics and data to support the process of improving learning. In this module the teacher is able to select what they want to visualize by searching keywords, subjects or student and then the tool will present the data for interpretation of what was requested.

• Module Answer Questions: This module allows the student to answer the questions that are provided by the teacher. The student must be logged into their account, not only to provide access, but also so that the responses are properly attributed to the student profile that answered each question available.

• Module Preview Results: Provides the student with a view of their performance in relation to the issue. Also allows their behavior to be monitored over the discipline that the student is registered to. This module differs from the analysis module by the fact that each student can only view their history, that is, each student has access to their own performance stored, while the results analysis module allows the teacher to see data from all students who are enrolled in subjects taught by him, making the teacher able to cross data and generate statistics.

• Database: refers to where the data that handled by the teacher and the student is stored, serving as a repository for inclusion, change, delete, and query the data.

While formulating the questions, the teacher can assign weights to every alternative. The weights can be 1, 2, 3, 4 and 5, where 5 is the correct answer and 4, 3, 2 and 1 represent the wrong answers. Wrong answers are arranged this way so that the teacher can analyze the behavior of the student to answer questions. If the student marks the answer weighing 4, that means that almost answered correctly. While, if the response has weight 1, it means that the student response was a big mistake and he has no clue about the matter. Since the tool allows to graphically analyze student’s responses and generate statistics on the evolution or involution of the students, the teacher can identify how the student is answering the questions and what is their level of trial and error. This is important for the teacher to make a unique work with students who have learning difficulties.
The central purpose of the tool is to serve as a technological tool to support education, encouraging and enabling teaching and learning to have a detailed assessment of each individual student in the educational environment. The result of the proper use and application of the tool is a considerable improvement in the teaching-learning process, making it dynamic and personalized. We believe that our proposal can significantly improve the learning process.

3.1 Student Environment: Resources and Possibility

The student's environment is where the student will be when there is work or evaluations available from the teacher of the subject that they are enrolled in. Fig. 2 shows the data that the student can view.

![Student Environment - Answer Questions](image)

The features are basic and do not allow any editing or deleting. The student will find a simple interface where they will be able to answer a test or a quiz as if they were responding on a paper, the only difference is that the student will not be able to enter data to configure the environment. In order to facilitate the work of the teacher and make the task of uniting keywords and work with the matter of weights easier, all questions should have options of answers, such as in multiple-choice questions, true or false, among others.

3.2 Teacher Environment: Resources and Possibility

The environment of the teacher is much more complex and is where everything happens. There, the teacher can create evaluations in similar way they would for printing, but instead they will have to provide the answers, the weight of each one of them, and keywords. Each test and each question will have keywords attached to them to provide the connection between content, subjects and disciplines. When searching for a test, you don't need to know the date it was created, or search through various tests, you can just list the topic it contained and thus find all quizzes related to that topic. When looking for the performance of a particular student or a
particular class, you can cross the results of performance against certain tag, to assess which part of the content as a whole the students had difficulty, or that student as an individual had difficulty at some general topic.

The weights work along with the tags so that each one of the answers already provided by the teacher can carry a value, where 5 is the highest weight, attributed to the correct answer, and 1 the lowest. There won’t be more than one correct answer, but there will be sentences that relate better to the correct one. That way, the teacher can add alternative or sentences that have a lot to do with the content of the question and are very similar to the correct alternative, for these the weights can be 4 or 3. But when an alternative has absolutely nothing to do with the content requested, then that one will have the minimum weight, demonstrating that the student did not have a clue about the subject and was not slightly mistaken, and that the student did not know about the issue and thought that an alternative that had no relation to the question was correct. The Fig. 3 presents the teacher environment where it is possible to configure the questions.

On the left side of Fig. 3, we can notice the options that the teacher has to add a name to the test, select a discipline within the ones they teach and add keywords to the test. On the right, there is space to add questions (one at a time) in multiple-choice format (in this case). In the center of the screen the teacher adds a title for the question, a statement explaining what must be answered and the alternatives. Optionally, you can search through the database to reuse saved files, allowing full editing.

In the case of Fig. 3, the question refers to the color of the sky. The standard answer to this question would be "blue", however, a student thinking of the night, could answer black and
another one thinking about cloudy days, could answer gray. These two alternatives have wrong weights attributed to them, but they are medium since they missed the obvious answer to this question but they understood what it was, and only interpreted in different ways. This simple example can show them how to work the weights. Notice that the green option has the lowest weight, because it is a far miss from the correct answer.

4 OUR PROPOSAL

The central application of the tool will be made in classrooms. The results obtained for analysis will make it possible to the process of teaching and learning to become individual while tests are still being applied in mass. Currently, students learn as a whole in the classroom and there is not always space for each one to draw their questions in particular. The teacher analyzes the performance of the class as a whole and in case of failure, the student studies all the content again. Using this tool, you can analyze each individual student and also know exactly what content or subject within a discipline is difficult to absorb within the students.

In addition to the benefits in the learning field, various dynamics can be created to facilitate the studies. Teachers can identify students who have difficulty with certain contents and unite them with students who have ease and these can become monitors, for example. Small groups of students can be trained for tutoring in certain subjects when the need is apparent. The tool does not need necessarily to be used in an evaluation method for grading purposes, but can be used whenever a new topic is addressed, or every 5 days, for example, to always keep measuring the level of knowledge acquired by the students and analyze where a booster is needed.

5 CONCLUSIONS AND FUTURE WORKS

In this article we presented the Taes, a tool for analyzing the evolution of student learning. Our goal is to create opportunities for teachers with a tool of easy manipulation that encourages the use of educational technologies in the classroom seeking greater participation and student interest. The Taes allows the teacher to define quizzes and apply these them in the classroom using a computational environment.

One of the advantages of Taes is that it allows the teacher to create questions by assigning weights to the answers. Depending on the student's answer, the teacher can analyze how wrong the student was. This allows an assessment of the evolution or involution of the student and allows the teacher to intercede in time to reverse negative situations. In many cases, using traditional methods of evaluation, it is too late to detect the difficulty of each student. In this sense, the Taes enables a rapid and punctual analysis, showing the teacher how the student erred on an issue, rather than determining that it just wrong.

As a future work, we plan to apply the tool in classrooms to analyze its performance, usability, its potential of improving the quality of teaching and learning as well as enhance its functionality and add new mechanisms. We are also interested in research on the identification of profile similarity students, recommending actions when faced with learning problems and design version for use on mobile devices running Apple operating systems, Android and Windows Phone.

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REFERENCES


